Obstacle Avoidance Testing

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# Purpose

Test the efficiency of the robot’s ability to avoid incoming obstacles when navigating to a specified waypoint.

# Decision

The obstacle avoidance logic will be implemented into the final project if the robot successfully avoids all created scenarios.

Measurements

For each scenario, the robot will be tested on its ability to avoid an obstacle. Therefore, a failure occurs when the robot collides or rubs any obstacle.

# Test objective

The objectives are to confirm the robot’s ability to avoid obstacles, to look for any weak-points and specific scenarios where the obstacle avoidance logic would fail.

# Assumptions

The obstacles will not be located at the edge of the competition area, because the robot may fall off the play area if it tries to avoid the obstacle.

# Procedures

For each run, the robot will be placed at grid location (1,1) facing north and will navigate to (1,3), and then (3,1).

There are a total of three scenarios: normal, extreme case 1 and extreme case 2.

Each scenario will have 10 runs. If the robot fails to avoid an obstacle, a detailed description will be provided for that run.

# Expectations

The robot should be able to avoid obstacles in normal case and extreme case 2 fairly easily and arrive at destination with accuracy better than 2 cm. However, for Extreme Case 1, the robot may fail to avoid as the angled obstacle may cause the robot to not perceive the block once it tries to reorient itself upon exiting the first obstacle avoidance mode. If the robot fails, a different placement of the front ultrasonic sensor may be needed.

Scenarios  
Normal case: Simple block that prevents the robot from advancing forward.

Figure 1. Normal Case: Only one obstacle is present and the obstacle is placed at an angle perpendicular to the robot’s orientation when encountering the obstacle.

Figure 2. Extreme Case 2: Multiple obstacles, one after the other, placed in such a way that the robot will enter many obstacle avoidance mode.

Figure 3. Extreme Case 2: Multiple obstacles, one after the other, placed in such a way that the robot will enter many obstacle avoidance mode.

# Test report

Table 1. Obstacle avoidance run. The test was performed following the procedure as described above.

|  |  |  |  |
| --- | --- | --- | --- |
| Run | Normal Case | Extreme Case 1 | Extreme Case 2 |
| 1 | Pass | Fail | Fail |
| 2 | Pass | Fail | Fail |
| 3 | Pass | Pass | Fail |
| 4 | Pass | Fail | Fail |
| 5 | Pass | Pass | Fail |
| 6 | Pass | Fail | Fail |
| 7 | Pass | Fail | Fail |
| 8 | Pass | Fail | Fail |
| 9 | Pass | Fail | Fail |
| 10 | Pass | Fail | Fail |

# Analysis

## Normal case

The robot successfully passed the normal case, it was able to avoid the obstacles easily. The accuracy of the destination arrival remains poor, but will be improved once the odometer and odometer correction is calibrated and improved.

## Extreme Case 1

The robot failed to pass the extreme case 1: it entered obstacle avoidance, but the left side of the wheel collided with the obstacle once it exited obstacle avoidance. This is due to the fact that the way the block was angle caused the robot to not advance forward enough to avoid the obstacle. Occasionally, the robot would succeed in avoiding the obstacle, but it is most probably because of the initial orientation, which shows that the obstacle avoidance logic is not reliable.

## Extreme Case 2

The robot failed all the runs for the extreme case 2. It entered obstacle avoidance every time it sees an incoming obstacle from the front. However, the robot fails to drive to its final destination, because after the second obstacle avoidance, it would try to navigate back to the waypoint. However, it would always run back to the first obstacle and repeat the same process thus, stuck in an infinite loop.

# Conclusion

The Obstacle avoidance V1.1 is not reliable as it failed the two extreme cases. However, it is able to avoid successfully in a normal case, but the obstacles present in the final competition is not known. Therefore, better obstacle avoidance logic is necessary to ensure its success rate.

# Action

A new obstacle avoidance will be implemented (Obstacle avoidance V1.2), where a wall follower logic will be implemented and further test will be performed to confirm its efficiency.

# Distribution

Software Development

# Follow up

Eric Vuong Obstacle Avoidance Test 2 V1